ENERGY CENTER
OF WISCONSIN

February 18, 2005

TO: Wisconsin Potential Study Advisory Committee and stakeholders

FROM: Ingrid Kelley, ECW

RE: Advance materials for February 23 stakeholder meeting

Below are advance materials for the February 23, 2005 Potential Study Stakeholder meeting covering the following four markets:

1. (8:30-11:00 am) — **Agriculture Anaerobic Digestion for Heat & Power**
2. (12:00-2:30 pm) — **Customer Sited Commercial Wind Power**
3. (2:30-5:00 pm) — **Wood Residue for Commercial Heat**

(If you are planning to attend this meeting, and have not already done so, please RSVP to sbenzmiller@ecw.org.

A generic discussion guide follows, along with some facts about the markets to be discussed and some issues I have identified. These are simply meant to get the discussion going; they're not intended to limit the scope of the discussion.

Draft

Resource characterization: Agricultural methane recovery

There are over 1.2 million cows on Wisconsin dairy farms. The average number of cows per farm is 81, and there are over 15,000 dairy herds in the state.[1] At present, estimates for the economically efficient use of manure as a source of methane to produce electricity and heat require at least 500 cows. According to the 2002 Census of Agriculture – State Data, there are 189 dairy farms in Wisconsin with herds of at least 500 head. If efficient systems could be developed for herds as small as 200 head, an additional 650 farms could become potential producers of methane for electric and heat energy. Other types of livestock operations could be considered as well.

The biogas produced from manure is about 60% methane and 40% carbon dioxide. "Pure methane has a heating value of 912 BTU/ft^3 (at standard temperature and pressure). Since biogas is only 60% methane its heating value is 40% lower at about 540 BTUs/ft^3."[2] The most economically efficient methane systems utilize the heat produced by the generator and incorporate the digester's solids into the farm's production cycle as animal bedding or for other uses. The whole system also serves the farm operation as a primary odor reduction strategy.

Market Channels and Actors

1. Farm operations with 500 or more head of dairy cows or number of other livestock to produce a comparable volume of manure
2. Third party energy developers
3. Utilities

Motivations for Installing an Agricultural Anaerobic Digester in Wisconsin

1. Manure management strategy to reduce odor
2. Reduction of greenhouse gas emissions and other pollution avoidance
3. Production of byproducts of the process
4. USDA grant program
5. Cooperation/participation of investor owned utilities in development of anaerobic digestion

Barriers to Achieving the Potential for Agricultural Anaerobic Digestion in Wisconsin:

1. Initial system cost
2. Ongoing operation and maintenance requirements
3. Present system design is too site specific to be economical
4. Transmission and distribution limitations
5. Need for business models that transfer risk away from farmers

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[1] *2004 Dairy Producer Survey*, Wisconsin Agricultural Statistics Service, December 2004

[2] Wright, Peter, *Overview of Anaerobic Digestion Systems for Dairy Farms*, Biological and Environmental Energineering Department, Cornell University, March 2001.

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Resource characterization: Customer sited, commercial scale wind energy for electrical generation

Wind turbines in Wisconsin generated 103.8kWh of electricity in 2003. This includes power from utility wind farms and small systems owned by individuals. While wind power currently provides only a tiny portion of the state's power needs, growth in the wind industry increased 122 percent since 2000.[1] A number of new utility projects currently being planned will further expand the capacity.

According to the U.S. DOE EERE State Wind web site, "Wisconsin has good wind resources in portions of the state."[2] EERE estimates that about 0.4% of Wisconsin land is both available and has a wind resource in class 4 or higher. Wisconsin's wind resource ranges up to about 16.5 miles per hour, with the greatest potential occurring in the central portion of eastern Wisconsin. (Include Wisconsin Wind Energy Potential map produced by WDOA Energy Division). Data for this map was gathered from 12 strategically located anemometers which measured wind speeds at a height of 60 meters. While the map illustrates the general wind resource picture, individual sites must still be analyzed because topography and other factors can influence the local wind energy potential.

Market Channels and Actors for Mid-sized Wind Turbines in Wisconsin

Until recently, wind energy development in Wisconsin has focused on utility-scale wind farms and small systems sized under 20kW, usually installed in rural residential settings. A new wind energy market is now showing great promise. Reconditioned utility turbines in the 35-65kW range are attracting the attention of farmers and small rural businesses whose total power requirements are close to this range and who are interested in site dedicated, grid connected wind power.

Motivations for Installing Mid-sized Wind Turbines in Wisconsin

1. Current incentives make immediate positive cash flow possible
2. Provides hedge against future raise in energy costs
3. USDA grant program
4. Substantial energy independence can be achieved
5. Reduction of greenhouse gas emissions and other pollution avoidance

Barriers to Development of Mid-sized Wind Projects in Wisconsin

1. Initial system cost/financing
2. Public policy support at all levels of government
3. Local acceptance of a wind turbine in the landscape
4. Need for business models that reduce economic risk for businesses

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[1] Wisconsin Energy Statistics 2004

[2] www.eere.energy.gov/state_energy/tech_wind.cfm?state=WI

5. Cooperation/participation of investor owned utilities in development of customer sited commercial scale wind turbines

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Resource Characterization: Wood Residue for Commercial/Institutional Facility Heating

Timber is an important resource in Wisconsin, providing the raw material for construction, furniture, textiles, chemicals and paper. Residue from this production is used primarily within the industry. According to the 1999 USDA Forest Service report, *Wisconsin Timber Industry – An Assessment of Timber Product Output and Use*, residue from Wisconsin production of solid wood products was used for fiber products (including paper pulp) (44%), on-site industrial fuel (24%), industrial fuel sold (7%), domestic fuel (5%), and miscellaneous uses (17%). Only about 2% of the residue was not used.[1]

Wood residue available for recycling as fuel comes from the waste stream as products are consumed. Once wood residue enters the waste stream it falls under two primary categories: municipal solid waste (MSW) and construction and demolition waste (C&D).

Because it is clean and easily separated on-site, wood waste from residential wood-frame construction is a highly recoverable wood residue resource. According to Falk and McKeever, out of an estimated 3.7 million metric tons of U.S. residential construction wood waste generated in 2002, 3.3 million metric tons, or about 89%, was recoverable. Demolition waste is more problematic because wood from demolition sites is frequently contaminated by paint or hazardous chemicals, or is in other ways more costly to recover. Falk and McKeever estimate only a 30% percent recovery rate for demolition wood waste.

The wood component in Municipal Solid Waste (MSW) from the residential, commercial, institutional and industrial sectors includes discarded wood products, containers and packaging, production waste from wood products manufacturing, and trees and woody yard waste. Solid wood waste (not including yard trimmings) totaled about 6% of all MSW in 2002 and Falk and McKeever estimate that 10% of this wood was recycled for other uses, and about 22% was combusted, primarily for producing energy. Programs for recycling wood from municipal tree removal and brush collection have focused primarily on chipping and composting methods, although this is a potential source of fuel. The use of wood residue as fuel requires a reliable supply that is of consistent quality. This supply must also be on site or within an economically viable transport distance. Construction waste and municipal tree and brush removal are potential future sources of waste wood for commercial heat.

Two sources of wood residue are reliable and available in their local areas. These are wood milling companies and others that make things of tree parts (non-pallet residue), and businesses that receive wood as shipping materials for other products and materials (pallet residue).

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[1] *Wisconsin Timber Industry – An Assessment of Timber Product Output and Use*, United States Department of Agriculture, Forest Service, 1999, page 8

Wood Residue in Wisconsin

According to the most recent *Wisconsin Wood Residue Study*,[2] each year the manufacturing sector in Wisconsin disposes of at least 500,000 tons of wood residue, or about one quarter of the residue it produces, costing businesses about $7,000,000 annually. Unutilized residue (both pallet and non-pallet) is primarily generated in southeastern Wisconsin although there are sources distributed around the state.

Market Channels and Actors

1. Businesses that produce wood products, or that handle wooden shipping materials in sufficient quantities to provide the fuel supply required to recycle this residue as heat in their own facilities
2. Businesses or institutions within range of an economically transportable wood residue source
3. As part of new construction or to replace a depleted system would require cost comparison of waste wood system with conventional natural gas or oil system
4. As replacement of a functioning conventional system for the purposes of saving on overall fuel costs

Motivations for Using Waste Wood for Facility Heating

1. Lower fuel costs – Comparative costs to other fuels (see Canadian Buyer's guide for 1998 comparison, or use newer data if available)
2. High availability, fairly stable prices
3. A proven technology that is highly flexible and can be used in a variety of applications
4. Indirect financial advantages:
    a. Wood waste is a product that primarily benefits the local economy because it is most cost effective when used locally, and because collection, processing and transport is more labor intensive than fossil fuel delivery, creating more jobs locally
    b. Source can be sustainably managed, and using the waste for heat eliminates environmentally negative disposal strategies
    c. CO2 neutral, very low to no sulphur in emissions (acid rain)

Barriers to developing Wisconsin's Waste Wood Energy Potential

1. The lack of an efficient and reliable infrastructure for recovering and transporting this material.
2. Space constraints on large units and fuel storage requirements: Closed storage of wet wood can deplete oxygen or cause spontaneous combustion; the latter can also happen with dry wood waste in closed storage

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[2] Everson, Vern A. and Hubing, Nicholas R., *Wisconsin Wood Residue Study: Wood Residue from Manufacturing Excluding Sawmills*, October 1993, Wisconsin Department of Natural Resources Bureau of Forestry, Publ-FR-075-93

3. Moisture content of wood waste can affect transport costs and efficiency in burning; also emissions are higher with more moisture
4. Source is the most important factor in costs, but alternative uses for the material may also drive up prices in the long run.
5. Collection/Recoverability of wood residue
6. Distance for transporting fuel/ geographic distribution of wood waste resources
7. Overall quality and energy content of wood waste varies
8. Greater complexity of technology requires higher level skill for O&M
9. Ash management and disposal
10. Air quality standards and other environmental approvals (for control of plume opacity, particulate emissions, greenhouse gasses, and carcinogens)
11. Availability and cost of fire insurance; other safety issues
12. Limitations on availability of information about these systems
13. Most systems have fossil fuel backup